U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF GRAINGER COUNTY, TENNESSEE.

BY

W. E. McLENDON AND W. S. LYMAN.

[Advance Sheets—Field Operations of the Bureau of Soils, 1906.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

[PUBLIC RESOLUTION—NO. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 27, 1907.

SIR: I transmit herewith a report and map covering a soil survey of Grainger County, Tenn. The survey of this county was undertaken in response to a request formulated by Justice Shields of the State supreme court in behalf of the farmers and interested citizens of the county, and transmitted through Hon. W. P. Brownlow. I recommend that this be published as advance sheets of the Field Operations of the Bureau of Soils for 1906, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SOIL SURVEY OF GRAINGER COUNTY, TENNESSEE.

By W. E. McLENDON and W. S. LYMAN.

DESCRIPTION OF THE AREA.

Grainger County, with an area of 196,672 acres, or about 307 square miles, is situated in the northeastern part of Tennessee, between 36° 5′ and 36° 30′ north latitude and 83° 15′ and 83° 45′ west longitude. Its greatest length is northeast and southwest, or parallel to the general direction of the ridges and mountains. It is bounded on the north by the Clinch River, on the east by Hawkins County, on the south by the Holston River, and on the west by Union and Knox counties. The extreme southwestern corner is only about 18 miles northeast of Knoxville.

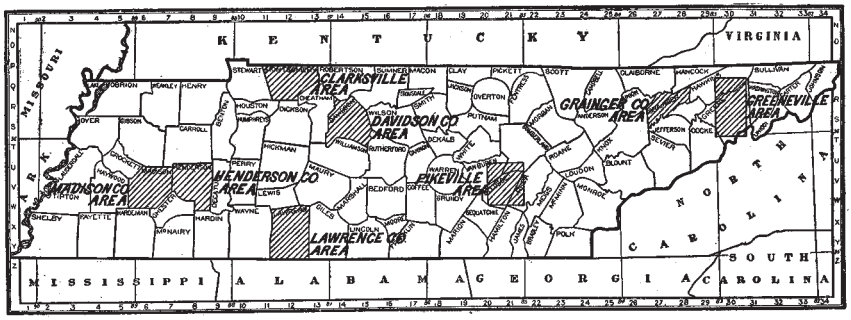

FIG. 1.—Sketch map showing location of the Grainger County area, Tennessee.

The county has a decidedly hilly and mountainous appearance. It is traversed a little north of the center by Clinch Mountain, which is a continuous steep-sided ridge with an elevation of 2,000 to 2,600 feet above sea level. The territory north of the mountain consists of a series of very rolling and broken mountainous ridges, divided by narrow, rolling valleys. The principal valley here is between Clinch Mountain and Copper Ridge. It is known locally as the Clinch Valley. Copper Ridge is paralleled on the north by Log Mountain and War Ridge, and beyond these by Hinds Ridge. They are all badly gorged and are occasionally cut by creeks draining the successive valleys toward the Clinch River on the north. Clinch Mountain is paralleled on the south by Poor Valley Ridge and a broken highland rim known as Richland Knobs. Between the two ridges is Richland

Valley, comprising a strip of moderately rolling lands from 1 mile to 2 miles wide. Poor Valley, which is deep, narrow, and of a generally broken character, divides Clinch Mountain and Poor Valley Ridge. From the crest of Richland Knobs on south to the Holston River is high rolling country with local differences in elevation of 100 to 300 feet. The creek and river bottom lands are so narrow that they are an inconspicuous feature in the general landscape, although of considerable importance agriculturally. The elevation of the valleys and rolling uplands is from 1,000 to 1,300 feet, and of the ridges from 1,400 to 1,600 feet, above sea level.

Clinch Mountain forms a general drainage divide between the two rivers, except at the western end of the county, where a part of Clinch Valley is drained by Big Flat Creek around the mountain into the Holston River. Poor and Richland valleys are drained by German and Richland creeks and their tributaries. The territory south of Richland Knobs is drained partly by German, Richland, and Buffalo creeks, and partly by numerous smaller streams flowing directly into the Holston River. The drainage into the Clinch River is mainly through Williams, Puncheon Camp, Notchy, Indian, Dutch Valley, and Hogskin creeks. The creeks as a rule parallel the valleys for some distance, then turn abruptly and cut through the ridges toward the larger courses of drainage.

Some of the first immigrants into Tennessee made their homes in what is now Grainger County. Most of the settlers came from Virginia, North Carolina, and South Carolina. Their descendants constitute the bulk of the present population. Except in local sections the county has always been thinly settled.

The county for a region so sparsely settled has an extensive system of public roads. They are not usually kept in very good repair, and many of them are too hilly and rough to allow heavy hauling. Most of the travel across Clinch Mountain is done on horseback. Rural mail delivery has been established over a number of routes.

The Middleboro branch of the Southern Railway traverses Clinch Valley about halfway across the county from the west, then turns abruptly to the north through Williams Creek gaps in Copper Ridge and between War Ridge and Log Mountain, and passes to the northeast through Dutch Valley on out of the county. From Coryton, on the Middleboro branch, a few miles west of the county, the Knoxville and Bristol Railway branches off to the southeast into Richland Valley, which it follows to within about 5 miles of the eastern boundary, then turns to the southeast, connecting with the main line of the Southern Railway at Morristown a few miles across the Holston River. Along these roads are stations and sidings at convenient intervals. In the southern part of the county most of the shipping is

done over the line of the Southern Railway between Morristown and Knoxville.

All of the towns of the area are small. Rutledge, the county seat, has a population of about 300. Some of the smaller places are Blaine, Joppa, Washburn, Powdersprings, Leas Springs, Tate Springs, Noeton, and Tampico. There are country stores at a number of the cross roads. Tate Springs, which is about 1½ miles northeast of Tate Springs Station, is one of the most noted mountain resorts of the East. Knoxville and Morristown are the chief local markets and shopping places. Some of the wheat crop is handled by local water mills, the remainder going to outside markets. Poultry and eggs are shipped out every Friday to northern markets. The Southern Railway operates a fast through freight for this purpose. During the summer months Tate Springs consumes large quantities of poultry and garden products. Smaller quantities go to Leas Springs, Mineral Hill Spring, and Avondale Springs. The cattle go mostly to southern markets.

CLIMATE.

The climate of the area is somewhat more variable than in the less mountainous sections of Tennessee. Clinch Mountain has a decided local modifying influence upon the rainfall, especially during the summer months, when it is not an uncommon thing for it to be raining hard on one side of the mountain while perfectly clear on the other side. The precipitation generally is heaviest on and near the mountain.

The summers are pleasant and nearly free from oppressive sultry periods. As a whole they are too short to allow the growing of cotton as a staple crop. The winters generally are mild, except for occasional very cold snaps. July is the hottest and February the coldest month of the year. The annual precipitation is about 50 inches and the normal annual temperature about 57° F.

The early warm days and the erratic occurrence of killing frosts during the early spring months make the fruit crop uncertain, unless care is exercised in locating the orchards so that they will not be too forward. For Knoxville, which is only a short distance south of the area, the average dates for the last killing frosts in the spring and the first in the fall are April 4 and November 7, respectively.

The following tables are compiled from records of Weather Bureau stations at Springdale and Knoxville. The results given for either place may be taken as fairly representative of Grainger County.

Normal monthly and annual temperature and precipitation.

Month.	Springdale.		Knoxville.		Month.	Springdale.		Knoxville.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	In.	°F.	In.		°F.	In.	°F.	In.
January	36.3	4.26	37.7	5.53	August	74.5	4.57	74.8	4.07
February	39.4	5.01	42.3	5.32	September	67.9	2.63	69.3	2.70
March	46.5	5.32	47.6	5.37	October	55.7	2.40	57.6	2.79
April	56.0	3.78	58.2	4.95	November	45.9	3.24	46.6	3.81
May	64.5	3.91	66.2	3.92	December	38.6	3.93	39.9	4.11
June	73.2	4.42	73.6	4.10					
July	75.3	5.55	76.4	4.32	Year	56.1	49.02	57.5	50.99

Dates of first and last killing frosts.

Year.	Springdale.		Knoxville.		Year.	Springdale.		Knoxville.	
	Last in spring.	First in fall.	Last in spring.	First in fall.		Last in spring.	First in fall.	Last in spring.	First in fall.
1897	Apr. 18	Oct. 29	Apr. 11	Nov. 12	1901	Apr. 22	Oct. 5	Mar. 22	Nov. 5
1898	Apr. 8	Oct. 15	Apr. 8	Oct. 27	1902	Apr. 18	.....	Apr. 8	Nov. 28
1899	Apr. 17	Sept. 30	Apr. 2	Nov. 5	1903	Apr. 24	Oct. 24	Apr. 5	Oct. 25
1900	May 3	Nov. 6	Apr. 1	Nov. 9	Average.	Apr. 20	Oct. 18	Apr. 4	Nov. 7

AGRICULTURE.

The early settlers, being in very moderate circumstances and far away from trading centers, had to rely almost entirely upon their farms for food supplies and material with which to make clothing. With corn as the most extensive crop, smaller areas were devoted to hemp, flax, tobacco, and a number of other crops intended mostly for home use. Nearly every farmer raised his supply of meat and kept at least a cow or two. Some also kept small herds of sheep, while others gave most of their time to raising and buying up cattle for distant markets. Wheat soon became an important crop on all of the better upland soils. Much of this was ground for home use at local water mills. A system of agriculture similar to that prevailing in the area at the present time was gradually evolved as it became better settled and was provided with better marketing facilities. About the time of the civil war the crops intended for clothing purposes were abandoned, but the custom of growing a home supply of tobacco is still practiced by a few.

As in other mountainous sections the farmers have been very slow to change to labor-saving machinery and more improved methods of agriculture. Some are trying to farm such steep hillsides and rough, stony lands that only the simplest kind of implements can be used. Others are trying to farm under such unfavorable circumstances that

they are barely able to make a living. Even on the better lands there is a large class of farmers that have not made much headway. They are using old and crude machinery. There is a general lack of attention to the problem of maintaining the productiveness of the soil, and the importance of thorough tillage and cultivation has never been realized. The plowing is generally shallow, and the rows are frequently laid off without any regard to the lay of the land. A noticeable feature in the county is the large proportion of land reduced to a very low state of productiveness, and the many hillsides that have been rendered practically worthless by erosion since they were brought under cultivation.

A larger acreage is devoted to corn than to all of the other crops combined. It is grown on all types of soil, regardless of topography or productiveness. On the rough shale lands and on some of the rough, stony limestone areas it is the only crop grown to any extent. The best corn lands are the alluvial and colluvial stream bottoms, for which purpose they are used very extensively. These produce anywhere from 30 to 60 bushels per acre. Next in productiveness comes the Cumberland loam, the Decatur clay loam, and the less stony areas of the Decatur clay; then the Clarksville loam, the Dekalb silt loam, and the Holston loam, and the other limestone types where they are not too stony to be cultivated. The rough shale lands produce good crops in spots where the soil has considerable depth, but as a whole the yields are light. The bulk of the crop is consumed at home.

Wheat is the second crop in importance, and oats third. Many others are produced in a more limited way, among which may be mentioned sorghum, millet, clover, and the grasses. No vegetables are grown except for home use, and as a rule the family garden does not receive much attention. Nearly every farmer has a few apple trees, which do fairly well without any special care. A few have begun the growing of apples and peaches on a commercial scale. Stock raising, while not an extensive industry, is beginning to receive more attention than heretofore. Except with a few farmers the cattle are scrubs and grades, and do not command the highest price on the market. Practically all of the oats grown are consumed by the farm stock, the supply usually lasting a short while during the summer months.

The census of 1900 gave 30,188 acres in corn, producing 510,500 bushels; 16,547 acres in wheat, producing 116,760 bushels; 3,104 acres in oats, producing 26,190 bushels; and 3,489 acres in millets, clover, and grasses, producing 3,340 tons of hay. At that time the orchard and forest products were valued at $25,670 and $31,412, respectively. According to the same authority a total of 1,000 acres was devoted to Irish and sweet potatoes, and to miscellaneous vegetables. A great deal of the land rated in the census report as improved is lying idle and grown up to weeds. Some areas afford fair pasturage

from wild grasses. Most of the timber of any commercial value has been removed from the area in farms. Portions of the mountains and high broken ridges are still fairly well timbered with oak, chestnut, and scrubby pines. Even here such of the timber as can be sawed into lumber is being rapidly removed. The lumber industry affords employment for a number of men, some of whom farm a part of the year.

Corn lands generally are prepared in the spring just before planting time, the methods employed varying somewhat with the character of the land. For the most part the corn is cultivated in low ridges. A great deal of the cultivation on the steep hillsides and very stony areas has to be done with the hoe. Very few of the farmers plant cowpeas between the corn, a practice so extensively followed in some sections of the South. Some strip or "pull" all of the fodder. A more commendable practice is where the entire stalk is cut and shocked. Most of the corn is slip shucked from the stalk and housed that way. None of the heavy types of machinery are used in gathering the crop.

Wheat and oats generally follow corn, but in some instances they are planted after cowpeas and clover. Occasionally fallow lands are used for the purpose. When wheat follows corn, the corn either is gathered just before the wheat is planted or is left standing in the shocks until late fall. The land is broken, then harrowed with a spike-tooth or smoothing harrow, the small V-harrow pulled by one horse often being used. The grain either is broadcasted ahead of the plowing or is drilled in after the land has been prepared. A common practice is to apply the fertilizers along with the grain. Where the land is fairly level and fairly free from stones it sometimes is merely given a disking before the grain is planted. Some plant the wheat between the corn rows before the crop is gathered by broadcasting the grain and covering it with a bull-tongue plow. Only a few roll the land after the grain is planted. While wheat requires thorough preparation to get the best results, it needs a good firm seed bed which in many cases can not be had except by rolling. The seeding is done in September and October. Much of the crop is gathered by hand. After standing in the shock until dry it is sometimes stacked to await the rounds of the thrashing machines.

Part of the oat crop is planted in the fall and part in the spring, the spring planting usually being done before March 1.

The practice of a continuous system of general farming, without any special attention to the systematic and proper rotation of crops, has greatly reduced the productiveness of the soils of the area. By some the value of clover and cowpeas as land improvers is recognized, and they are used on a limited scale. Some of the lands intended for corn, or the small grains, are first planted in cowpeas. Some cut the crop for forage, returning only the roots to the soil. A few plow under

the whole crop. In most cases, the latter method is preferable. Where a heavy crop is to be handled in this way, liming may prove necessary to assist the proper decay of the organic matter. Another easy and cheap way of keeping the lands in a productive state is by planting cowpeas broadcast or in rows between the corn. At the present time very little of this is done. Some years ago commercial fertilizers came into very general use. As a rule they were applied merely to increase the yields without any consideration of what they contained or what their after effects on the soil would be. The results were very variable. Most of the soils being deficient in humus, the use of commercial fertilizers resulted in a condition known by the farmers as "killing" or "burning out" of the land. So within the last ten years their use has been practically abandoned, except for the wheat crop. For this crop an average of about 300 pounds to the acre is applied at the time of seeding.

Only the broader soil adaptations are recognized. The tendency is to grow the same general line of crops regardless of the types of soil used. The wheat crop is confined largely to the better limestone soils. The few attempts at growing apples have been made on the Clarksville loam. The peach orchards are found on the sandstone and sandy shale areas.

Raising stock has received little attention, except at the hands of a few. The herds kept are usually scrubs or grades and not especially fit for milking purposes or for beef. Here and there a farmer has turned over a part of his land to improved grasses for grazing purposes, and made special provision for taking care of his stock during the winter months.

Land values in the county are still comparatively low. The Clarksville loam, the most extensive type, can be bought at an average price of $10 an acre. The rough mountainous lands are valued largely for the timber they support. The shale loams are valued at from $3 to $5 an acre. The most desirable soils are the Decatur clay loam, the Cumberland loam, and the Huntington loam. These are valued at $30 or more an acre.

The farms vary in size from 25 to 500 or more acres. The average size of farms, according to the census of 1900, is 85.9 acres. Sixty-one per cent are operated by the owners. Only a few tenants rent on a cash basis. When the landowner merely furnishes a house with the land, he gets a third to a half of the crop, to be divided at the barn. If he also furnishes the stock and implements he gets two-thirds of the crop.

The question of labor has not caused the farmers any serious concern, as most of them operate on a small scale and rely upon their families to do most of the work. At such times as they need special help they generally can get it from the near-by families. Within the

last few years so many negroes have been attracted to the railroads that labor is getting higher priced and scarcer every year. The usual day wage is 75 cents and one meal. The monthly wage ranges from $15 to $20.

The county has a great variety of soils and local conditions that will admit of a wide range of crops and methods. That the farmers as a class are not in a thrifty condition is not due altogether to the broken and nonproductive character of the soils, but partly to a general tendency to grow certain crops whether the soils are adapted to them or not, and partly to the methods employed, which are not conducive to the best results especially so far as they concern the maintenance of the productiveness of the soils. The steep hillsides that were once good land have been cultivated until in many places they have been ruined by erosion and abandoned. Whereas if they had been devoted to clover and grasses they would have afforded the best of pasturage for all time. Only the better lands can be used profitably for cultivated crops. For some of the sandstone and sandy shale lands peaches would prove a paying crop. Many of the stony limestone areas could best be devoted to apples. Aside from a few special crops the rougher lands should be seeded to grasses and clover and devoted to dairying and stock raising, two of the most promising industries for the area. On the better lands, stock raising would prove more profitable than the present line of farming if gone about in a businesslike way. The system of general farming now practiced could be made to give better returns than at the present time by adopting more thorough methods of tillage and by giving more attention to the rotation of crops, so as to keep up the productiveness of the soil, and to the adaptation of soils to crops so as to insure the greatest returns from the area handled. It always costs more to build up worn-out lands than it does to keep them in a productive state.

SOILS.

Grainger County is in the Appalachian Valley, one of the geographic divisions of the great Appalachian province, extending from central Alabama to northeastern Pennsylvania. The rocks, in general, consist of crumpled and folded conglomerates, sandstones, shales, limestones, and marbles of varying degrees of purity and hardness. They were deposited as ocean sediments during the different eras of Paleozoic time, and were subsequently metamorphosed and elevated into highland. Within the limits of Grainger County the rocks in the process of elevation and mountain making were so badly crumpled and folded that they now occur at the surface at various angles, and usually in narrow belts. The mountainous topography

is largely the result of erosion. The shaly ridges have been held up by bands of resistant sandstone or limestone.[a]

With the exception of the small alluvial and colluvial strips which represent a mixture of material from different formations, the soils bear a direct relation to the underlying rocks, and in most places their boundaries are as easily outlined as those between the rocks themselves.

The agricultural areas of the sandstones and shales give rise to a group of soils known as the Dekalb series. The sandstones give rough stony areas and a stony loam; the rougher areas of the sandy shales interstratified with narrow bands of shaly sandstone and limestone, a shaly silt loam; the rougher areas of calcareous and argillaceous shales, a shale loam, and the level and gently rolling areas of the calcareous and argillaceous shales, a silt loam.

The Knox dolomite, the most extensive formation in the county, is a cherty magnesian limestone. It weathers into soils of the Clarksville series and in local slightly cherty areas to other loamy types. The Newman limestone, which is also cherty, weathers into a stony loam. The other limestones give separate types, differing from one another in color, texture, and the amount and character of undecomposed rock appearing at the surface.

When the Holston River was at a higher level it built up terraces of considerable extent over the limestones and shales along its course. These terraces in the county are outlined in the two types mapped as Cumberland loam and Holston loam. The Cumberland loam includes only those areas where the underlying rock is limestone. The soil was originally from alluvial material, modified by local wash from the limestone uplands, but much of this has been removed by erosion, the resultant soil being further modified by residual material from the underlying limestone. The Holston loam bears the same relation to the shale formation as the Cumberland loam does to the limestone.

One bottom land type was mapped. It occupies the narrow overflow strips of the Holston and Clinch rivers, representing material transported for some distance and thoroughly reworked by stream action. It is found also in narrow strips along the creeks draining shaly areas.

[a] For further information concerning the geology of the area, in all of its phases, see the Maynardville and Morristown folios of the United States Geologic Atlas.

Fourteen types of soil were recognized and mapped. Their names are given in the following table in the order of their extent:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clarksville loam	80,448	40.9	Moccasin stony clay	3,840	2.0
Clinch shale loam	26,752	13.6	Dekalb stony loam	3,008	1.5
Grainger shale loam	20,288	10.3	Huntington loam	5,824	2.9
Decatur clay	15,040	7.6	Cumberland loam	1,792	.9
Rough stony land	14,976	7.6	Holston loam	1,472	.8
Hagerotown stony clay	9,792	5.0	Newman stony loam	896	.5
Decatur clay loam	6,592	3.4	Total	196,672	
Dekalb silt loam	5,952	3.0			

NEWMAN STONY LOAM.

The soil of the Newman stony loam, to a depth of from 7 to 9 inches, is a light-brown friable silty loam, rendered stony by angular chert and shaly limestone fragments, and by frequent outcrops of massive limestone on the steeper slopes. On some of the gentle slopes, and in some of the hillside depressions, loamy material has accumulated to a depth of 18 or more inches, making a mellow brown soil of more lasting productiveness than the slopes where the soil is being made shallower and being deprived of its humus by erosion.

The subsoil is a yellowish to reddish-brown silty clay loam to an average depth of 24 inches, there changing into a silty clay of about the same color. The stony content of the subsoil is essentially the same as that of the soil. While there is from 10 to 30 per cent present in both soil and subsoil, it does not greatly affect the water-holding capacity or productiveness of the type. It does, however, make the soil very difficult to till satisfactorily.

The only area of the Newman stony loam mapped is in the extreme eastern end of the county, 2½ miles northeast of Tate Spring. The topography of this area is broken and mountainous. Some of the slopes are entirely too steep to be cultivated, while others are too rough and stony.

This type is derived from the Newman limestone, which contains numerous nodules of chert. In the upper layers it generally has a shaly structure, but lower down it becomes more nearly massive. It is the massive layers that outcrop on the slopes. A few small areas of this limestone are found farther west, and are so intimately associated with the shale formations that the resultant soil is similar to that from the shales proper.

Less than one-half of the type is under cultivation. Corn yields from 10 to 20 bushels per acre. Clover and bluegrass do so well that there is every reason to believe that the greatest opportunities upon

this type are in the line of stock raising. While corn, wheat, and oats may give fine yields in some years, the slopes are too steep to be used for cultivated crops. They deteriorate rapidly under cultivation and the expenditure of labor and money is too great for the returns.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Newman stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15844	Soil	1.7	3.4	1.2	3.7	6.5	65.4	17.4
15845	Subsoil	2.9	4.3	1.6	4.0	4.4	61.1	21.9

CLARKSVILLE LOAM.

The Clarksville loam varies considerably because of the rolling topography it occupies. Some of the differences existed before the land was cleared, while others have resulted from cultural methods and erosion in cultivated areas. In its most extensive development, the surface soil, 8 to 12 inches deep, consists of a grayish to yellowish-brown silty loam, containing anywhere from 1 to 10 per cent of angular fragments of chert. Usually there is a greater accumulation of chert on the surface. The soil proper is noticeably deficient in humus, except in local areas. As a rule, it has a more distinct brownish cast and is less silty in cultivated areas than where it is still timbered. On account of the sharp chert in the soil it is locally known as "skinfoot" land.

The subsoil consists of a yellowish heavy but friable loam grading into a reddish stiff clay, also carrying a small amount of chert. This clay generally extends to a depth of 10 or more feet before solid rock is reached and usually becomes redder with depth. Locally the subsoil grades through a yellowish-brown clay loam into clay at a depth of 18 to 24 inches.

Immediately along the small creeks and drainage ways are very narrow strips of colluvial material washed down from the adjacent slopes. The soil here is deep, mellow, and of lasting productiveness. There is rarely ever enough chert in the soil to alter materially its character or to interfere seriously with tillage. A number of small areas, however, occur which contain enough chert to justify mapping as Newman stony loam had they been of sufficient size.

The Clarksville loam is by far the most extensive type in the county. The largest area occurs in a broad strip along the southern boundry of the county. Smaller strips occur north of Clinch Mountain on Copper

Ridge and a narrower broken ridge along Clinch River. The topography of these areas ranges from rolling to hilly, with local differences in elevation of 50 to some 350 feet. They are traversed by an intricate system of streams, most of which are intermittent in their flow. The divides usually are rounded ridges separated by deep V-shaped valleys.

The Clarksville loam is a residual soil. It is derived from the Knox dolomite, a light-gray to bluish cherty magnesian limestone. The chert, being very resistant to weathering agencies, is left as irregular fragments over the surface and to a less extent through soil and subsoil. The limestone does not come near the surface, except along a few steep slopes, where it outcrops in local spots.

A large percentage of the type is cleared, but numerous areas are no longer cultivated. The areas lying idle were abandoned after a long period of injudicious farming which allowed them to run down so in productiveness that they can not be farmed profitably under the present system of management. Some of the abandoned areas have been ruined almost beyond redemption by erosion. The principal crops grown are corn and wheat. Oats, sorghum, cowpeas, and grasses are grown on a more limited scale. Cattle raising is not an important industry, but a few farmers have small herds. Apples do exceptionally well, but so far only a few orchards have been planted for commercial purposes. Corn produces from 10 to 25 bushels and wheat from 8 to 20 bushels per acre. The average yield of wheat is about 10 bushels per acre.

All hillside areas used for cultivated crops or for orchards should be terraced to prevent erosion. The steeper slopes, where most of the soil has already been removed, could be profitably and permanently improved by planting to Bermuda grass, which makes a very tough sod and affords excellent pasturage. They would also grow good bluegrass, orchard grass, redtop, and some other hardy grasses if first improved by turning under a crop of cowpeas.[a] On the type in general more attention should be given to stock raising and apple orcharding.

The table on following page gives the average results of mechanical analyses of fine earth samples of this type of soil:

[a] A determination of the manurial requirements of this soil by the wire basket method developed the value of applications of organic matter, great increases in plant growth following the use of cowpea vines or stable manure. The action of mineral fertilizers and lime in this test was not such as to warrant the recommendation of their use where it is feasible to employ legumes in rotation instead.

Mechanical analyses of Clarksville loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15840, 15842	Soil	1.7	4.7	4.5	7.7	6.3	55.8	18.9
15841, 15843	Subsoil	.7	1.9	1.2	2.1	1.1	30.2	62.3

DECATUR CLAY LOAM.

In typical areas the soil of the Decatur clay loam to a depth of 8 to 12 inches consists of a brown to reddish-brown heavy but friable loam. In local eroded spots it is red, shallow, and has about the texture of a clay loam, while in the slight depressions it is darker, mellow, and deep. The subsoil to a depth of several feet is a reddish-brown to red clay, practically free from fragments of stone. Where the soil is deepest the subsoil usually grades through a brown clay loam into a clay at an average depth of about 18 inches. Here and there over the type are local outcrops of limestone, but these are not numerous enough to offer any serious interference. This soil is one of the easiest upland types to till and to keep in a productive state.

The Decatur clay loam is not extensively developed in Grainger County. The largest areas are found in Richland Valley, forming almost a continuous strip from Blaine, through Rutledge, and on out of the county east of Tate Springs. South of Ada is an area of about a square mile in extent. The surface features are only rolling enough to provide good drainage.

The areas in Richland Valley are derived from the Rutledge limestone, a blue massive limestone which in weathering does not leave many fragments in the residue. Excepting a few small eroded areas, which were classed with the Decatur clay, the Decatur clay loam is the only type derived from the Rutledge limestone. Another narrow strip of this limestone occurs at the bottom of the valley between Copper and War ridges. It has been eroded down and buried in most places by wash material from the higher shale ridges. The area south of Ada is derived from a bluish phase of the Knox dolomite, which is much less cherty than the general run of the formation. The soil here is somewhat more compact than that from the Rutledge limestone, but the two have about the same agricultural value.

Nearly all of the Decatur clay loam is under cultivation and all crops of the area do well. Small areas are devoted to grasses and pasturage. The type is used for corn, wheat, and oats. Corn produces from 20 to 40 bushels, wheat 10 to 20 bushels, and oats from 30 to 50 bushels per acre. Cowpeas and sorghum give large yields. Apples thrive when given proper care.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechnical analyses of Decatur clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15864	Soil	0.3	3.3	3.8	10.0	11.2	45.1	25.6
15865	Subsoil	.2	1.9	2.9	6.4	6.4	33.2	48.0

HAGERSTOWN STONY CLAY.

The soil of the Hagerstown stony clay, from 3 to 6 inches deep, varies from a yellowish-gray silty loam in level areas to a brown, clammy clay loam in rolling areas. The subsoil is a dingy yellowish-brown tough clay, underlain at a depth of 12 to 36 inches or more by undecomposed limestone. Except in the more level areas, where the clay is several feet deep, the limestone outcrops in numerous thin ledges which parallel one another and usually stand only a few inches above ground. In places the soil is literally covered with flaggy fragments of limestone in a partially weathered state. Some areas are too stony to be used at all for agricultural purposes, while others are only fit for pasturage. The type is further modified by local narrow strips of marble that could not be separately mapped. The marble outcrops in numerous massive fragments, but between these is a brown loam or clay loam underlain by a reddish-brown friable clay. Most of these strips are too stony to be cultivated.

Two long, narrow strips of the Hagerstown stony clay occur north of Clinch Mountain. One of these extends across the county through the lower part of the valley between Clinch Mountain and Copper Ridge, and the other occupies the entire northern slope of War Ridge. Another strip is found in the southwestern corner of the county extending across a large bend of the Holston River. Local areas are fairly level, but the greater portion of the type is rolling and badly cut up by numerous small streams.

The Chickamauga limestone, from which the typical areas of this soil are derived, is a blue or gray massive and shaly limestone, varying considerably in the hardness and composition of the different layers. As this formation wherever exposed stands almost vertically it weathers very irregularly and outcrops in all of the more resistant layers. The strip through Clinch Valley is interstratified with Holston marble, and the one in the southwestern corner of the county by Holston marble and local strips of Tellico sandstone. These three formations weather into quite distinct soils, but their limited extent and their broken topography made it necessary to group them as one type.

Limited areas are under cultivation and devoted principally to corn and wheat. Even the stony areas produce fair crops of corn in wet seasons, but as a whole they are too droughty and rough to be used for this purpose. Corn yields from 10 to 20 bushels and wheat from 8 to 15 bushels per acre. Clover and grasses do well wherever there is enough soil for them to get firmly rooted. The few small areas where the clay is deep and free from stone can be cultivated profitably to a variety of crops. The stony areas should be seeded to clover or some of the more hardy grasses and used for pasturage. By doing this what is now practically worthless land could be made to give profitable returns.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Hagerstown stony clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15860	Soil	1.7	3.5	1.9	3.4	4.2	52.0	32.9
15861	Subsoil	.5	1.8	.9	2.4	3.4	48.6	41.4

MOCCASIN STONY CLAY.

The Moccasin stony clay consists of a dark-brown, tough, silty clay, associated with numerous ledges of limestone standing almost vertically and projecting only a few inches above the surface. The clay varies in depth from a few inches between the close ledges to 3 or more feet where the ledges are less frequent or absent. This clay is difficult to till, but where it has much depth it is a strong, productive soil. To cultivate some areas, it is necessary to run the rows between the ledges, and there are many small spots that are too stony to be cultivated at all.

This type occurs in a long, narrow strip just south of the Hagerstown stony clay in Clinch Valley. The two strips have essentially the same surface features, but are quite different in color and are recognized as being different agriculturally. This clay is derived solely from the Moccasin limestone, which differs from the Chickamauga limestone principally in having a peculiar brown color given to it by ferruginous material.

Practically all of the original timber growth has been removed. Scrubby cedars are now taking possession of many of the stony knolls and slopes. Small areas are under cultivation, some are used for pasturage, while many others are lying idle and being ruined by erosion. Corn is the principal cultivated crop, yielding anywhere from 10 to 30 bushels per acre. The better yields are obtained

where the clay has some depth, as all cultivated crops suffer badly from droughts where the soil is shallow. Clover and grasses make a luxuriant growth and stand well, but not much attention is given to this line of farming. This soil can be best used by seeding it to clover and a variety of grasses for pasturage.

The following table gives the results of mechanical analyses of the fine earth of the soil and subsoil of this type:

Mechanical analyses of Moccasin stony clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15868	Soil	0.0	0.8	0.4	2.3	3.8	45.2	47.3
15869	Subsoil	.0	1.2	1.5	2.6	2.2	49.4	42.7

DECATUR CLAY.

The Decatur clay consists of 4 to 6 inches of a reddish-brown clay loam or friable clay, underlain by a very red stiff clay. At various depths below 18 inches the clay gives way to massive limestone, which outcrops extensively as large fragments and broken ledges. Sink holes are common throughout the type. The steeper slopes and local areas in nearly every field are very stony. The more level areas vary in stoniness from pure rock outcrop to areas where rock does not appear in quantities sufficient to interfere with cultivation. The soil works up fairly well, but in nearly all areas it would be greatly improved by the presence of more organic matter.

The most extensive areas of this type are on the lower northern slopes of Richland and Copper ridges. Several smaller areas are found just north of the Holston River. All of these areas have a moderately rolling to hilly and broken topography.

With the exception of a few small areas, the Decatur clay is derived from the Maryville limestone and is the only type from that formation. The area south of Indian Ridge is from the Holston marble and Tellico sandstone mixed. The soil here is a deep Indian red, very friable clay loam, 12 to 15 inches deep, underlain by a friable clay loam or clay of about the same color. Its very limited extent made it necessary to include it with the Decatur clay, which it most resembles. A few small eroded areas from the Rutledge limestone were also classed with this type.

Most of the type has been cleared, but only a small percentage of it is under cultivation. Some of the more stony areas are still timbered with cedar and more rarely with oak and other deciduous trees. The cultivation of some areas has been made possible by the removal of large quantities of stone. Corn is the chief crop, although

some wheat is grown where the land is not too stony.[a] Corn yields on an average not more than 12 to 15 bushels and wheat 8 to 12 bushels per acre. If this soil was not stony it would be one of the best upland types in East Tennessee. Because of its stony character it would give better returns if devoted to grasses and cattle raising. Clover stands well and bluegrass makes an excellent sod. Some attention is already being given to this line of farming with good results.

The following table shows the results of mechanical analyses of the fine earth of the soil and subsoil of this type:

Mechanical analyses of Decatur clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15850	Soil	0.7	2.7	3.9	8.2	6.5	44.9	33.8
15851	Subsoil	.1	.7	1.1	2.6	2.4	23.4	68.8

DEKALB SILT LOAM.

The Dekalb silt loam to a depth of 6 to 9 inches is a light yellowish gray friable silt loam. Below this it is a gradation through a heavier silt loam into a light yellowish brown shaly clay retaining some of the original shale structure. At a depth of 3 or more feet the clay becomes more shaly and rapidly gives way to a mass of partially weathered shale. The soil does not contain enough shale fragments to change its character except in local rolling and eroded areas. It is deficient in humus, and has a tendency to run together and develop a clammy structure when rained upon.

This is a residual type, derived mainly from the level and gently rolling areas of the Rome formation, where it is more uniform in texture and has weathered to a greater depth than in the broken hills. The areas immediately north of the railroad, between Rutledge and Tate Springs, are derived from the greenish argillaceous shales of the Rogersville shale formation. The soil and subsoil here are heavier and have a more compact structure than in the areas from the Rome formation. A part of the wide strip north of Blaine is derived from the argillaceous and calcareous shales of the Sevier shale formation. The others are mostly from the calcareous shaly areas of the Nolichucky shales. Except the areas from the Rogersville shale

[a] The results of a test of this soil by the wire-basket method showed that no very marked effects followed the use of any of the fertilizers, although increases were obtained where nitrogen was used alone, or in complete fertilizer, or where stable manure was added to the soil. Where practicable to give this very stony type the proper amount and kind of tillage, much may be done with stable manure to maintain its fertility.

near Tate Springs, which are low and level, the type is well drained naturally.

All of the Dekalb silt loam is cleared and devoted to corn, wheat, and a few other crops of less importance. It grows fairly good grasses, but does not provide as good pasturage as the limestone types.[a] Corn yields from 10 to 25 bushels and wheat from 8 to 15 bushels per acre. Only a limited acreage is devoted to oats.

The following table gives the results of mechanical analyses of the soil and subsoil of Dekalb silt loam:

Mechanical analyses of Dekalb silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15852	Soil	0.8	1.6	0.8	2.4	21.7	59.6	13.2
15853	Subsoil	.2	.8	.5	2.0	15.2	48.4	32.7

Dekalb

CLINCH SHALE LOAM.

The Clinch shale loam has a gray to brown shaly soil, 5 to 10 inches deep, varying in texture from a friable silt loam to a medium heavy clay loam. On many of the eroded slopes the soil consists of rotten shaly material with only enough clay and silt to make it loamy. The gray colors are usually found where the soil is formed in place and the underlying rock has weathered considerably to a depth of several feet. The darker colors are more in evidence on the slopes and in the depressions where there has been sufficient soil creep and landslides to build up deep loamy areas.

The subsoil varies as much as the soil. In places it consists of soft, greenish-gray and light-brown partially weathered shales, while in others it is a yellowish-brown shaly silt-clay. The depth to solid shales rarely exceeds 3 feet. The very shaly areas occupy the badly eroded slopes, some of which are too steep to cultivate.

This is next to the most extensive type in the area. It occupies the northern slope of Clinch Mountain, Richland Ridge, and the lower northern slope of Copper Ridge, as well as a number of small areas in the eastern end of the county and along the Holston River.

The areas south of Ada and on Clinch Mountain are derived from the Sevier shales. The very narrow strips associated with the Decatur clay loam are from the Rogersville shale. The remaining

[a] From a study of the manurial requirements of this soil by the wire basket method, the most satisfactory treatment would seem to be some form of nitrogen (that applied in the test in the form of nitrate of soda), and its value was demonstrated in all combinations into which it entered. The use of leguminous crops in the rotation is thus indicated,

areas are derived from the Nolichucky shale. The Sevier and Nolichucky shales weather into similar soils, but as a whole the one from the Nolichucky shale has a browner color, is more shaly, and has a higher clay content. The strips from the Rogersville shale and those along the Holston River from the Nolichucky shale consist of fine shale without any loamy soil covering.

The Clinch shale loam is not considered a very productive soil. Numerous areas are too steep and broken to be cultivated. The areas under cultivation are devoted largely to corn, oats, wheat, and sorghum, and grasses are grown to a limited extent. Wheat does not do so well as oats. Clover and grass stand well and make a good growth. Corn yields from 10 to 25 bushels, wheat 7 to 10 bushels, and oats 20 to 40 bushels per acre. No fruits are grown except a few apples for home use.

The best opportunities afforded by the type are in the line of stock raising.

The average results of mechanical analyses of samples of this type of soil are shown in the following table:

Mechanical analyses of Clinch shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15854, 15856	Soil	2.0	7.3	2.4	3.8	7.6	51.8	24.2
15855, 15857	Subsoil	2.8	10.4	3.6	6.6	6.6	40.9	28.5

GRAINGER SHALE LOAM.

The soil of the Grainger shale loam to a depth of 6 to 9 inches is a gray to brownish silt loam, or very fine sandy loam, containing numerous shaly sandstone and soft shale fragments. On some of the higher steep slopes sandstone outcrops in ledges and as massive fragments. In the vicinity of these sandstone streaks the soil is more nearly a fine sandy loam, but where derived from the close-bedded calcareous and sandy shales of the lower slopes it is a true silt loam. The browner colors prevail on sheltered slopes and in depressions where the soil is deep and loamy.

The subsoil varies from a yellowish heavy silt loam to a light-brown silty clay. Its shaly content increases with depth and gradually gives way to solid rock. In numerous small areas both the soil and subsoil are little else than a mass of soft shale, varying from green to yellowish-brown in color.

The Grainger shale loam is a broken, hilly, and mountainous type. It includes Poor Valley Ridge and the shaly belts of Lone Mountain, Log Mountain, and War Ridge, all of which are characterized by deep gorges and frequent gaps.

It is a residual soil derived from calcareous and very fine-grained sandy shales interstratified with thin layers of sandstone. The different areas are from different formations. The one on Lone Mountain is from the Rockwood formation, and those of Log Mountain and War Ridge are from the Rome formation, principally the sandier or lentil phase. The belt occupying Poor Valley Ridge is partly from the Grainger shale and partly from the lentil phase of the Rome formation. These formations possess differences easily recognizable, though not of such a nature as to influence greatly the soil. The soil areas have the same timber growth, surface features, and agricultural value.

Small areas here and there are cultivated to corn, and to a few other crops in a more limited way. The remainder of the type is forested with scrubby pine, chestnut, and oak. The cultivated areas are confined largely to the lower slopes. Corn rarely yields more than 10 bushels per acre. Peach trees do well; but very little attention is given to orcharding. With the exception of fruit growing, the type is too rough and unproductive to make remunerative crops.

The following table gives the results of mechanical analyses of the fine earth of the soil and subsoil of this type:

Mechanical analyses of Grainger shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15858	Soil	3.4	4.4	1.1	2.3	9.2	67.2	12.3
15859	Subsoil	4.3	8.5	2.4	4.8	8.2	58.6	13.3

DEKALB STONY LOAM.

The soil of the Dekalb stony loam consists of 4 to 8 inches of a gray to light-brown sandy loam, varying from fine to medium in texture. In the virgin state it contains only a small supply of humus, and most of this disappears after a field has been under cultivation a few years. The subsoil varies with the depth of the weathered material from a yellowish to reddish-brown sandy clay, where it is more than 3 feet deep, to a yellowish-brown heavy sandy loam in the shallower areas. Fragments of sandstone, some of which are very large, are strewn over the surface and through the soil mass.

The Dekalb stony loam is a mountain-side type from the Clinch sandstone, and includes the lower talus slopes and such other areas on the higher slopes as are susceptible of cultivation. The rougher stony areas were classed as Rough stony land.

More than one-half of the areas mapped are under cultivation. Corn, which is the only crop grown to any extent, gives very light

yields. It does not pay to try to cultivate this soil to any of the general farm crops. Peaches would prove a remunerative crop on favorably located areas. A few promising young orchards were seen at the time of the survey.

ROUGH STONY LAND.

Rough stony land is a term applied to broken, stony areas that are of no value except for the small amount of timber and the little scant pasturage they afford. The character of the soil varies with the different formations. That from the Clinch and Bays sandstones occupying the southern slope and crest of Clinch Mountain is a sandy loam similar to the Dekalb stony loam. These lands are timbered very largely with chestnut, scrubby shortleaf pine, and oak.

Another strip of rough land occupies the upper northern slope of Richland Ridge, and includes a limestone resembling very closely the more massive portions of the Chickamauga limestone. Being a much more resistant rock than the shales on either side, it is responsible for the prominence of the ridge. It is timbered with oak, dogwood, and other deciduous trees.

A few small areas were also mapped from the Knox dolomite and the Holston marble. Those from the Knox dolomite occur along the Holston River and consist of steep, rocky bluffs. A great many areas of Rough stony land, too small to show on the soil map, occur all through the Hagerstown stony clay, Moccasin stony clay, Decatur clay, Newman stony loam, and Grainger shale loam.

CUMBERLAND LOAM.

The Cumberland loam consists of a brown loam changing with depth into a lighter brown clay loam, then into a yellowish to reddish-brown silty clay at about 12 inches below the surface. There is very little change in the subsoil to a depth of several feet. The soil is rather heavy, but it is well drained and contains enough humus to make it friable and fairly easy to till. It is naturally a strong soil and is easily kept in a productive state.

The Cumberland loam is of limited extent. It occurs as high river terraces that have been modified by erosion. The original sediments of these terraces were partly of purely alluvial material brought down from a distance by the river and partly of colluvial wash from the higher limestone uplands. Much of this material has been removed by erosion, so that in places the soil now is little else than residual material from the underlying limestones. This is especially true in rolling areas where the texture approaches a clay loam or clay. Here and there over the surface are rounded waterworn bowlders and pebbles. The base rock is always a limestone in contradistinction to the shales under the Holston loam. The surface features range from nearly level to rolling.

This soil is prized for all crops grown in the area. It produces good crops of corn, oats, wheat, and grass. Apple trees do well. No alfalfa was being grown at the time of the survey, but it is a desirable soil for this crop. Sorghum and cowpeas give heavy yields of forage. Corn produces 25 to 40 bushels, wheat 12 to 25 bushels, and oats from 30 to 50 bushels per acre. Corn and wheat are the most extensive crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Cumberland loam:

Mechanical analyses of Cumberland loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15846	Soil	0.4	3.3	3.5	7.4	4.6	61.6	18.8
15847	Subsoil	.3	2.4	2.9	5.6	10.2	51.0	28.2

HOLSTON LOAM.

The Holston loam is a yellowish-gray silty loam or very fine sandy loam, 8 to 10 inches deep, underlain by a yellowish-brown silty clay or very fine sandy clay slightly mottled with redder colors in the lower depths. The subsoil is free from gravel, but in places the surface is strewn with waterworn gravel ranging up to some 4 inches in diameter. The soil is generally deficient in humus and when dry it has an ashy-gray surface appearance.

The general topography of this type is the same as that of the Cumberland loam. During the earlier history of the section when the Holston River flowed at a much higher level, terraces were built up, a part of the material having been brought down by the river and part by smaller streams from the adjacent shale uplands. As the river lowered its channel these terraces were left above overflow. They then began to be eroded away just as were the higher uplands, and most of the alluvial and colluvial material was finally removed. Now the soil is partly of the terrace sediments and partly from the underlying shales, modified by the sand and gravel left in the process of erosion.

The Holston loam is not recognized as a productive type, except in a few of the more level areas. Even the better areas are inferior to the Cumberland loam. A large percentage of the type is under cultivation. Corn and wheat are the principal crops. Limited areas are devoted to oats, sorghum, cowpeas, hay, and pasturage. Corn yields from 15 to 25 bushels and wheat from 8 to 20 bushels per acre.

Being very limited in extent, its manurial requirements were not determined. The soil needs more humus, which could best be supplied by practicing a rotation in which cowpeas played an important

part. It is not necessary to plant the land solely to peas, as they can be grown very successfully between the rows of corn. They would mature a crop of seed that generally commands a good price on the market and the vines would be left to be incorporated in the soil. Wheat and oats would follow a mixed crop of corn and cowpeas much better than they would corn alone.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Holston loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15848	Soil	0.4	3.0	4.4	16.6	14.3	46.6	14.6
15849	Subsoil	.4	1.9	2.9	10.8	8.9	37.6	37.8

HUNTINGTON LOAM.

The Huntington loam is an alluvial type found along the streams. Occurring as narrow terraces along the Holston and Clinch rivers, the soil to a depth of 15 to 18 inches consists of a dark, slightly brownish fine loam resting upon a dark-brown, heavy, fine loam or clay loam which extends to a depth of 3 or more feet. In the low-lying strips along the small creeks the soil to a depth of 12 to 15 inches is a dark-brown friable loam resting upon a brown loam or heavy loam, and a noticeable characteristic is the presence of a small amount of shale and shaly sandstone fragments throughout the soil and subsoil. Some very narrow sandy strips occurring immediately along the water front, but too small to appear on the map, were included in this type.

Except for occasional overflow and a few small depressions, the natural drainage of the type is fairly good. Along the small creeks the type is both alluvial and colluvial in origin, most of the wash material being from shale formations.

All of the Huntington loam is practically improved land. The soil is well supplied with humus, is mellow, and naturally productive. Corn is the chief crop, the yields ranging from 30 to 60 bushels per acre, according to the season. Small, well-drained areas are sometimes sown to wheat or oats. The type is mostly prized as a corn soil, but is adapted also to hay and pasturage.

The results of mechanical analyses of a sample of the soil and of the subsoil of this type are given in the following table:

Mechanical analyses of Huntington loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15862	Soil	1.1	5.4	4.7	14.1	11.0	47.0	16.1
15863	Subsoil	1.0	2.0	1.5	6.7	22.7	51.3	14.7

SUMMARY.

Grainger County is situated in the northeastern part of Tennessee and comprises an area of 196,672 acres, or about 307 square miles. The county is decidedly hilly and mountainous. The Clinch River, which forms the northern boundary of the county, and the Holston River, the southern boundary, receive the principal drainage waters of the area.

Though the climate is somewhat variable, the winters, as a rule, are mild and the summers pleasant. The normal annual temperature is about 57° F., and the precipitation about 50 inches.

The early settlers came mostly from Virginia, North Carolina, and South Carolina, and the county is comparatively thinly populated. The towns are small. Rutledge, the county seat, has a population of about 300.

At present there is a larger acreage of corn than of all other crops combined. It is grown on all types of soil without much regard to adaptability. Wheat is the second crop in importance, and oats, sorghum, millet, clover, grasses, and vegetables are grown in a limited way. A small apple orchard is seen on nearly every farm, and stock raising is receiving more attention than heretofore. The most of the timber of any commercial value has been removed from the farms. Some portions of the mountains and high ridges are still fairly well timbered with oak, chestnut, and scrubby pine.

Little labor-saving machinery is used, and the plowing is shallow. Many hillsides have become almost worthless because of erosion. Much of the land of the area has deteriorated in productiveness, but a systematic rotation of crops would do much to bring it into a better state. Commercial fertilizers, though generally used several years ago, are now practically abandoned except for the wheat crop.

The farms vary in size from 25 to 500 acres, the average size farm, according to the census of 1900, being 85.9 acres. Sixty-one per cent of the farms are operated by the owners. Land values are comparatively low, the price ranging from $3 to $30 an acre. The question of labor is not of much concern to the farmers in this area, as the most of them do nearly all of their own work.

The county roads are numerous, but as is to be expected in a mountainous region they are rough and in the hilliest section do not admit of heavy hauling. Railroads crossing certain parts of the county afford fairly good transportation facilities.

Grainger County has a great variety of soils that will admit of a wide range of crops and methods. Fourteen types of soil were mapped in the area. With the exception of the small alluvial and colluvial strips which represent a mixture of material from different formations, the soils bear a direct relation to the underlying rocks, and in most places their boundaries are as easily outlined as those between the rocks themselves.

The Newman stony loam occupies a broken and mountainous area in the extreme eastern end of the county. Some of the slopes are too steep and others too stony to be cultivated. Less than one-half of the type is under cultivation. It is best adapted to clover and bluegrass, though some corn, wheat, and oats are grown.

The Clarksville loam is the most extensive type in the area and varies considerably because of its rolling and sometimes hilly topography. A large percentage of the type is cleared, but many areas after years of injudicious farming are now lying idle. The principal crops on the soil are corn and wheat Some oats, sorghum, cowpeas, and grasses are grown. The cultivated hillside areas should be terraced to prevent erosion, and the steeper slopes, where most of the soil is already removed, could be profitably improved by planting to Bermuda grass.

The Decatur clay loam is found mostly in the Richland Valley and in surface features is only rolling enough to provide good drainage. Nearly all of the type is under cultivation and all crops of the area do well upon it.

The Hagerstown stony clay occupies areas usually too rough and stony to be used profitably for cultivated crops. Limited areas are cultivated to corn and wheat with fair success. The type should be seeded to clover or some of the more hardy grasses and used for pasturage.

The Moccasin stony clay is similar in surface features to the Hagerstown stony clay, but is different in color and agricultural value. Small areas are under cultivation, corn being the principal crop. It is best suited to clover and grasses.

The Decatur clay, though mostly cleared, is cultivated only to a small extent. If not so stony this would be one of the best upland soils, but because of its stony character it would give better returns if devoted to grasses and cattle raising instead of being used as at present for corn or wheat.

The Dekalb silt loam is all cleared and devoted to corn, wheat, and a few other crops, the yields being fair.

The Clinch shale loam is next to the most extensive type in the county. It occupies the northern slope of Clinch Mountain, Richland Ridge, and the lower northern slope of Copper Ridge, as well as a number of small areas in the eastern end of the county and along Holston River. It is not considered a very productive soil. Corn, wheat, sorghum, and grasses are grown, but its best opportunities are in the line of stock raising.

The Grainger shale loam is a broken, hilly, and mountainous type. Small areas here and there are cultivated to corn and a few other crops and the remainder of the type is forested with scrubby pine, chestnut, and oak. Except for fruit growing the type is too rough and unproductive to make remunerative crops.

The Dekalb stony loam is a mountainside type, more than one-half of which is under cultivation. Corn, the only crop grown to any extent, gives very light yields. On favorably located areas peach orchards would do well.

Rough stony land is a term applied to broken, stony areas which are of no value except for the small amount of timber and scant pasturage they afford.

The Cumberland loam is of quite limited extent in this county, occurring as high river terraces that have been modified by erosion. It is naturally a strong soil and is easily kept in a productive state. It is suited to all crops grown in the area and the yields are good.

The Holston loam is not recognized as a productive type except in a few of the more level areas. Its general topography is the same as that of the Cumberland loam. The general crops of the area are grown on this soil.

The Huntington loam, an alluvial type found along the streams, is a mellow and productive soil. It is esteemed mainly as a corn soil, the yields being large, but is adapted also to hay and pasturage.

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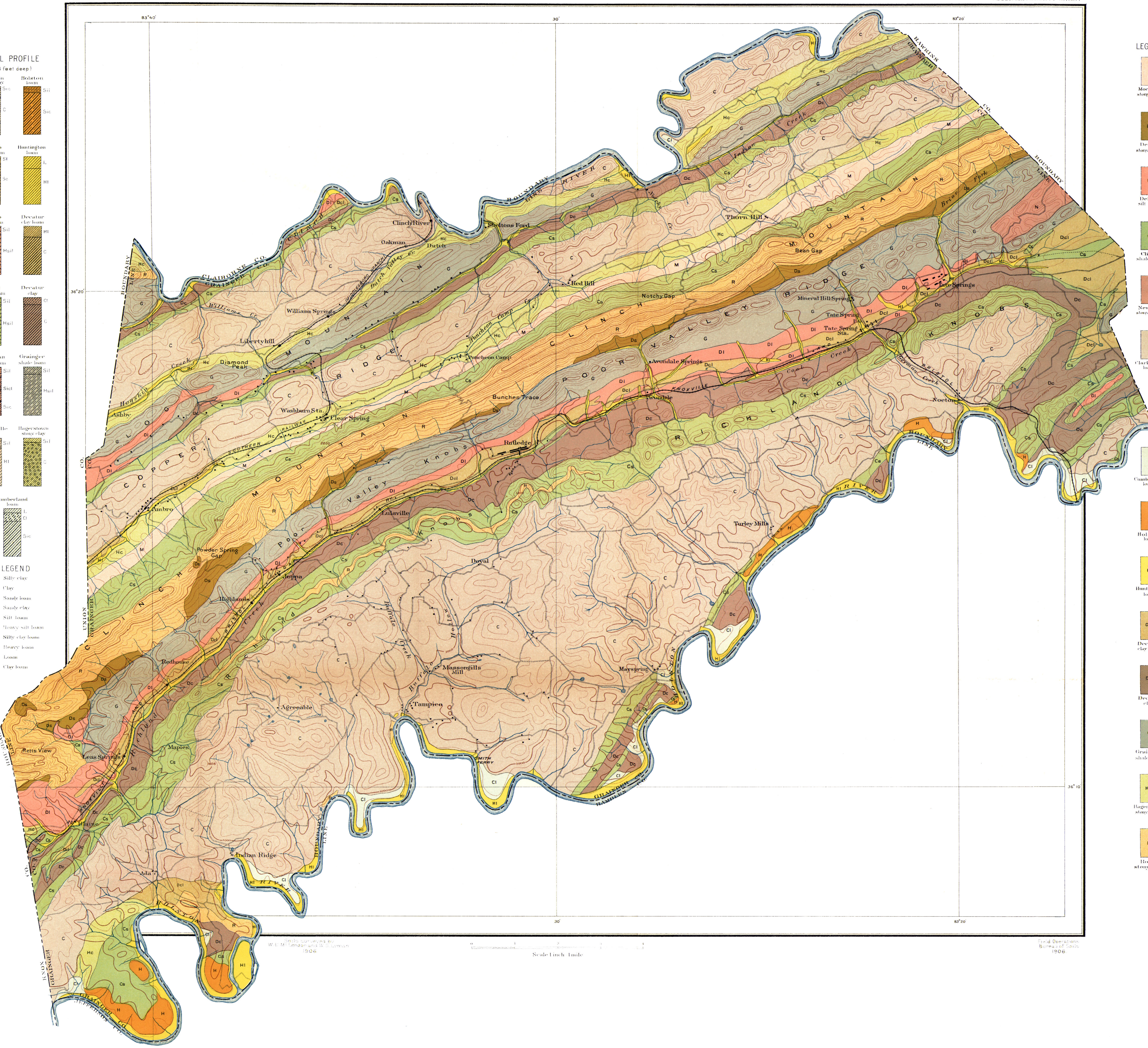
U S DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY CHIEF

SOIL MAP

TENNESSEE
GRAINGER COUNTY SHEET



SOIL PROFILE
(3 feet deep)

Moccasin stony clay: Sic, C
Holston loam: Sil, Sic
Dekalb stony loam: Sl, Sc
Huntington loam: L, Hl
Dekalb silt loam: Sil, Hsil
Decatur clay loam: Hl, C
Clinch shale loam: Sil, Hsil
Decatur clay: Cl, C
Newman stony loam: Sil, Sicl, Sic
Grainger shale loam: Sil, Hsil
Clarksville loam: Sil, Hl
Hagerstown stony clay: Sil, C
Cumberland loam: L, Cl, Sic

LEGEND

Sic	Silty clay
C	Clay
Sl	Sandy loam
Sc	Sandy clay
Sil	Silt loam
Hsil	Heavy silt loam
Sicl	Silty clay loam
Hl	Heavy loam
L	Loam
Cl	Clay loam

LEGEND

M	Moccasin stony clay
Ds	Dekalb stony loam
Dl	Dekalb silt loam
Cs	Clinch shale loam
N	Newman stony loam
C	Clarksville loam
Cl	Cumberland loam
H	Holston loam
Hl	Huntington loam
Dcl	Decatur clay loam
Dc	Decatur clay
G	Grainger shale loam
Hc	Hagerstown stony clay
R	Rough stony land

Soils surveyed by
W. E. McLendon and W. S. Lyman
1906

Scale 1 inch 1 mile

Field Operations
Bureau of Soils
1906.